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Segmented Ion Engine Plume Characteristics

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The segmented ion engine configuration divides a large engine into several identical smaller ion sources configured to have the same active grid area as the original large ion source. For example, a 2.3-kW, 30-cm diameter ion engine may be replaced by a segmented ion engine consisting of four 15-cm diameter ion sources in the manner shown in Fig. 1. These four ion sources (referred to as segments) are operated from a single power conditioning unit as suggested in Fig. 2. The chief advantage of the segmented engine configuration is obtained for planetary mission applications in which the ion propulsion system must be throttled over a large input power range. In this case the segmented engine is throttled primarily by turning on the individual 15-cm ion source segments. The segments which have been shut-off are no longer subject to wear. This results in a substantial reduction in the required service life of the ion source components for missions of interest such as comet and asteroid rendezvous.

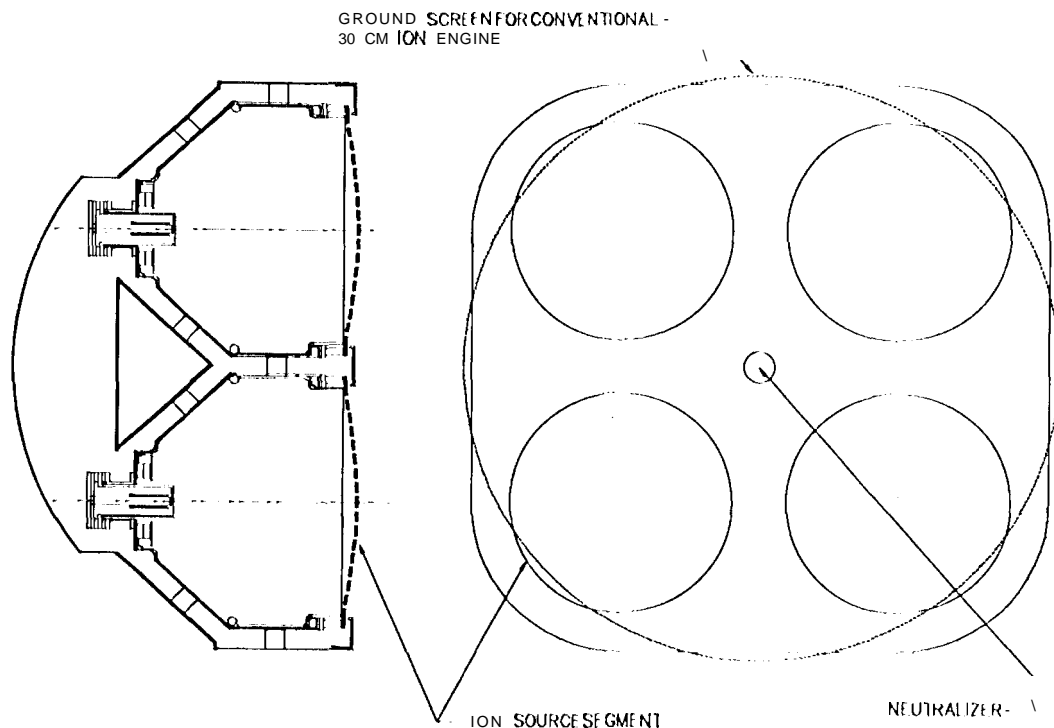


Fig. 1 Schematic diagram of the 4x15-cm segmented ion engine.

This paper describes the results of experiments performed to characterize the plume of the 4x1.5-cm (30-cm equivalent) segmented ion engine. Ion beam data with 1, 2, 3 and 4 segments operating are presented. The exhaust beam characteristics were measured with a Faraday probe rake, an $E \times B$ probe and a probe which determines the thrust vector location. Segment-to-segment interactions with multiple segments operating are also discussed.

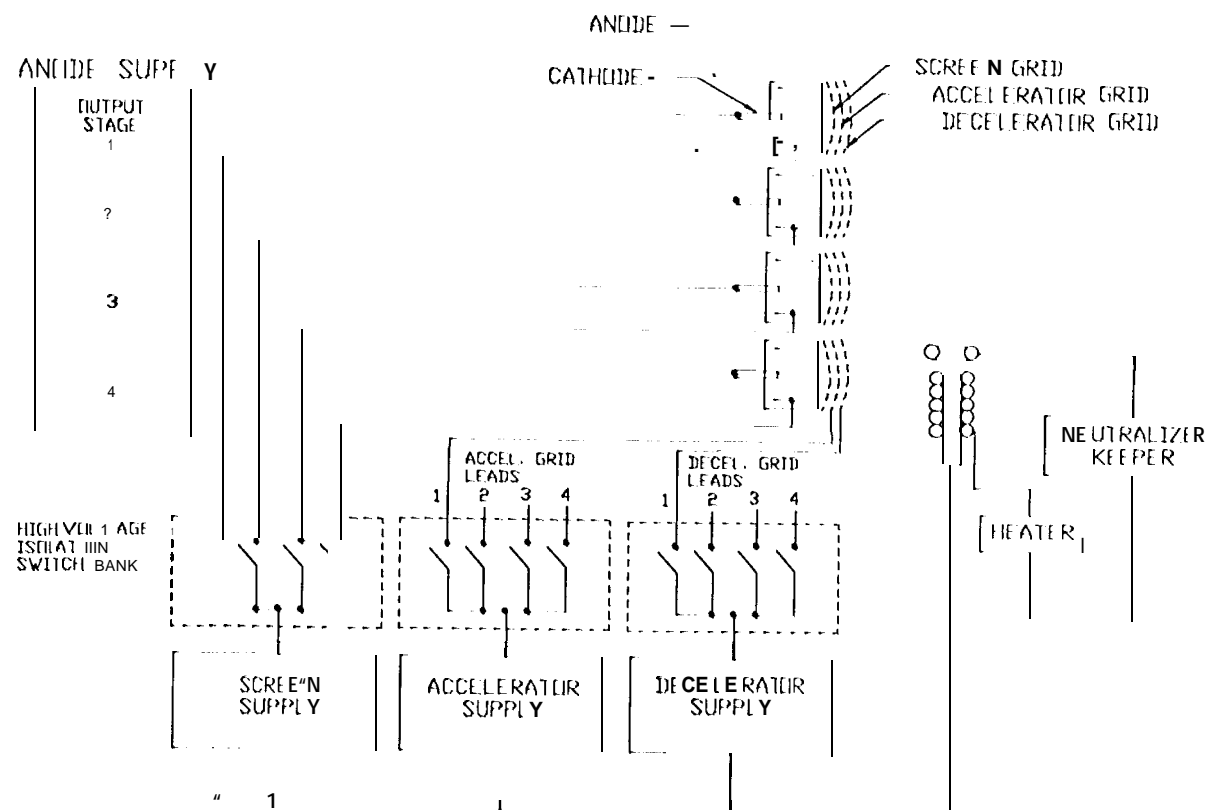


Fig. 2 Power processing block diagram for the segmented ion engine.